

CLAIMS

We claim:

1. A method of pre-computing costs of placing circuit modules in regions of circuit layouts, the method comprising:

5 a) defining a set of partitioning lines for partitioning the region into a plurality of sub-regions during a placement operation;

b) for each set of potential sub-regions, identifying a connection graph that traverses the set of potential sub-regions, wherein some of the connection graphs have edges that are at least partially diagonal;

c) identifying an attribute of each identified connection graph;

d) for each set of potential sub-regions, storing the attribute of the connection graph identified for the set.

2. The method of claim 1, wherein the connection graph for each set of potential sub-regions is the shortest graph that traverses the set of potential sub-regions.

3. The method of claim 2, wherein each connection graph is a Steiner tree.

4. The method of claim 1, wherein the attribute is the length, the method further comprising:

for each connection graph, identifying a bend-value;

for each set of potential sub-regions, storing the bend value of the connection graph

20 identified for the set.

5. The method of claim 4 wherein the bend-value of a graph specifies the number of diagonal bends of the graph.

6. The method of claim 1, wherein the partitioning lines form a partitioning grid.

7. The method of claim 1, wherein the partitioning lines are horizontal and vertical lines.

8. For a placer that partitions a region of a circuit layout into a plurality of sub-regions, a method of computing placement costs, the method comprising:

- a) for a set of sub-regions, identifying a connection graph that connects the set of sub-regions, wherein the connection graph has at least one edge that is at least partially diagonal;
- b) identifying a placement cost from an attribute of the connection graph;
- c) storing the placement cost for the set of sub-regions.

9. The method of claim 8, wherein the attribute is the length of the connection graph, and the placement cost equals the length of the connection graph.

10. The method of claim 9, wherein the length of the connection graph provides an estimate of the necessary wirelength for routing a net that has circuit elements in the set of sub-regions.

11. The method of claim 8, wherein the attribute is a bend value.

12. The method of claim 11 wherein the bend-value of a graph specifies the number of diagonal bends of the graph.

13. The method of claim 8 further comprising:

for each set of sub-regions,

- (i) identifying a connection graph that connects the set of sub-regions;
- (ii) identifying a placement cost from an attribute of the connection graph;
- (iii) storing the placement cost for the set of sub-regions;

wherein some connection graphs have at least one edge that is at least partially diagonal.

14. The method of claim 13, wherein the attributes are the lengths of the connection graphs, and the placement costs are the lengths of the connection graphs.

15. The method of claim 14, wherein each connection graph is a Steiner tree.